be done?" He sees his patients dying around him for lack of the knowledge which can only be obtained by experiment, and cannot but demand that the right to perform such experiments should be conceded to those who have qualified themselves for the task. There are those who say that, instead of trying experiments on the lower animals, medical men should experiment upon themselves; but, as Prof. Virchow points out, "Medical men are already more exposed in epidemics of all kinds in the performance of their duties in hospitals, in the country, in their nocturnal visits to the sick, in operations and necropsies, than any other class of the community as a rule; and it requires all the blindness of the animal fanatics to require also of them that they should test on their own bodies the remedial, or poisonous, or indifferent action of unknown substances, or that they should determine the limit of permissible doses by observations made on themselves." Nor is this all. Medical men do make experiments upon themselves, and some have sacrificed their own lives in such experiments. But such a method of observation is open to the objection that the sacrifice is to a great extent useless, as the death of the experimenter deprives him of the opportunity of recording the results of his experiment. Not only has the necessity for experimentation upon animals been clearly pointed out in the addresses delivered at the Congress, but this International Medical Congress itself, the greatest assembly of men qualified to judge in the matter that has ever been held, has expressed its judgment in the resolution passed, without a single dissentient, at its concluding general meeting:—

"That this Congress records its conviction that experiments on living animals have proved of the utmost service to medicine in the past, and are indispensable for its future progress; and accordingly, while strongly deprecating the infliction of unnecessary pain, it is of opinion that, alike in the interests of man and of animals, it is not desirable to restrict competent persons in the performance of such experiments."

THE BIBLE AND SCIENCE

The Bible and Science. By T. Lauder Brunton, M.D., D.Sc., F.R.S., &c. (London: Macmillan and Co., 1881.)

THIS work is in the form of seventeen lectures, which appear to have been delivered before an orthodox audience. Their scope is a wide one, ranging from sketches of ancient Egyptian and Israelitish life to the newest results in biological science. The principal object of the book is professedly that of showing how Darwinism is not antagonistic to Christian belief in general, or to the Mosaic account of creation in particular. But although this is the peg, so to speak, on which the course of lectures is made to hang, occasion is taken to devote the main part of the work to rendering in a plain and popular form an epitome of the leading facts of animal and vegetable morphology. This part of the work is admirably done. Indeed we do not know any writings of this nature better calculated to accomplish their object of making science easy to the general reader; and as the spirit is throughout tender, not to say sympathetic, towards traditional beliefs, the book deserves a large circulation among the always increasing class of persons who desire to learn, with a small amount of trouble and without fear of stumbling upon any cloven hoof, what biological science has done, is doing, and is likely to do. In a word, this part of the book, besides being written in a very graceful style, well exemplifies the truth that no writer is so able to serve up to the general public the facts of science in a palatable form as one who is himself a practical worker in the subjects which he expounds. In the interests of scientific education, therefore, we should like to see "The Bible and Science" pass through any number of editions.

Coming now to what is professedly the main object of the work, opinions of course will differ as to the success which has attended Dr. Brunton's efforts. And here it may be observed, first of all, that it is not very clear what the author himself thinks about the deeper topics that underlie his expositions. Apparently addressing an audience of the straitest sect, he judiciously steers clear of all topics save the one immediately before him, *i.e.* showing that the doctrine of evolution is not incompatible with that of the Mosaic cosmology; and although this is perhaps more effectively done than by many previous essayists, there is nothing to show that he is not adopting the method of St. Paul, which he commends, who "graduated his instructions to the people whom he was addressing, first giving them milk, and afterwards strong meat" (p. 358). Of course in this there is nothing to find fault. Because a man sticks to a text which does not happen to contain a confession of faith, we have no reason to object that he does not publish his religious opinions; only we think it well to point out that such is here the case, for any reader who is careless or obtuse might fail to perceive the adroitness with which Dr. Brunton steers his discussion among the rocks of dogma. At every point where we feel inclined to ask what our author himself believes, we virtually fall into a dialogue with him such as that with which is told of another eminent man—"What is your own creed?" "The creed of all sensible men." "And what is that?" "Sensible men never say."

But whatever Dr. Brunton's creed may be, his book everywhere breathes with such a genuine, and indeed we may say pathetic, appreciation of the beauty of the biblical writings and the nobility of religious belief, that if he fails to strike a chord which through all changes and chances is ever ready to vibrate deep down in the bass of human nature, we have only to commiserate the reader who has departed so far from the best and the purest of human emotions. Having travelled through Palestine, and knowing his Bible as thoroughly as his science, Dr. Brunton gives us some beautiful little sketches of Bible scenes, lighted up by numberless interesting suggestions derived from modern science, as well as by the glow of a singularly vivid imagination. Take, for instance, the following:—

"Never in my life do I remember a pleasanter moment than when I sat down on one of these, and looked at the scene before me, for this was the realisation of my childhood's dream; this was the spot where Joseph had lived. Yonder might have been the granaries where he received his brothers; here, in the neighbourhood, stood his house, where he returned, weary of his day's work, and was received by his lovely and loving wife Asenath,

> whose gentle care had obliterated from his mind, not only all the sorrows and trials of his early life, the hatred of his brothers, his slavery in Egypt, his temptations in Potiphar's house, and his long imprisonment in the dungeon, but had almost made him forget his dead mother, the kind old father who had loved him so well, and the little brother Benjamin to whom he had been so deeply attached, so that he called the name of his first-born son Manasseh, 'For God,' said he, 'hath made me forget all my toil, and all my father's house.' . . . Let us, in order to form an idea of the country, suppose Joseph at this time of the year to be starting on a tour of inspection, and let us in thought accompany him.
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> "He has said farewell to his wife and children. His chariot and horses are at the gate, he springs up, and, accompanied by his attendants, drives onward towards the southern point of the Delta, just where it joins the Nile valley. At first he proceeds amongst shady trees, bounded on either side by fertile gardens; but as he rides on, his path lies through a strip of hard sandy desert, in crossing which the hind legs of one of the horses ridden by his attendants suddenly becomes paralysed, the animal sinks upon its haunches, and the horseman falls backwards. The Cerastes, or horned snake, a little viper only about a foot long, lying concealed in the sand, which it resembles in colour, irritated by the passage of the cavalcade, has bitten the horse's heel. Immediately the poison spreads up the leg, paralysing it, and, when it reaches the spinal cord, paralyses it also, thus destroying the power of both hind legs, and causing them to give way under the weight of the animal. Only within the last year or two have we learned the exact manner in which such a poison as this acts upon the body; but centuries ago its general effect was well known, and no more vivid description of it could be given than that of the dying Jacob, who compared his son Dan to 'an adder in the way, a serpent in the path, biting the horse's heels, so that the rider falleth backwards.'"

In a similarly picturesque manner we are carried through sundry scenes of early Egyptian life, of the bondage of the Israelites, their exodus, wanderings, and conquest of Palestine. In the course of this exposition, which only errs from being too short, several interesting suggestions are made as to the possible origin of the accounts of some of the Pentateuch miracles. Thus, speaking of the plagues, he says:—

> "Amongst these was one that used to puzzle me not a little, the plague of 'darkness which might be felt.' Why, thought I, did all the people remain in the dwellings? Why could they not take lanterns with them and move out? But a day which I spent at Port Said showed me what was probably the reason. On waking in the morning it seemed to me that everything had been turned into pea-soup. Above, around, and on every side, was a thick yellow mist, darkening the air like a London fog, but differing from it in this respect, that it was a darkness perceptible; a darkness that might be felt, and painfully felt too, for it was caused by a storm of sand, driven by the wind, and every particle stinging the skin like a needle."

Again, regarding the passage of the Jordan, he writes:—

> "One of the puzzles of my childhood's days was to imagine the condition of the waters thus cut off, for I fancied to myself the River Jordan like such streams as I had been accustomed to, flowing through a small channel with level meadows stretching on either side. How then, I thought, did the waters stand up as in a heap? I could picture to myself a steep, glassy wall of water running across the channel itself, but was there likewise a level wall along each bank, or did the waters flow over the meadows on either side? On seeing the Jordan, however, I at once discovered the solution of my childhood's difficulty."

Then, after describing the double channel of the river—

> "Within this larger or outer channel, confined by its bank on either side, the waters of the river might become filled up as a heap. Here was an answer to one inquiry of childhood. There were no invisible or glassy walls, indeed, at the sides to prevent the waters from running over the surrounding country. Was there, then, one to draw them up in their channel, and thus to cut them off towards the Dead Sea? or was the dam here simply of earth? On standing at the river's brink, the whole scene appeared to pass before me. The country around is highly volcanic. Earthquakes occur with great frequency, and during such convulsions of nature we know that the relations of land and water become greatly altered. . . . Here, I thought, we have a method by which the Israelites were able to pass over dryshod. If the bed of the stream at this place underwent a sudden upheaval at the time of their passage, the consequences would be exactly those which are described in the Book of Joshua. The waters would rise up like a heap, filling the channel far up the valley, and those flowing down to the Dead Sea would be cut off.
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> "To some this explanation may seem mere fancy, but it appears to be the one accepted by the psalmist, for in the 114th Psalm we find, 'Jordan was driven back. The mountains skipped like rams, and the little hills like lambs. What ailed thee, O thou sea, that thou fleddest? thou Jordan, that thou wast driven back? Ye mountains, that ye skipped like rams; and ye little hills, like lambs? Tremble, thou earth, at the presence of the Lord, at the presence of the God of Jacob.' Here the psalmist seems to ask the question why Jordan was driven back, and to give us indirectly as an answer that the earth trembled, or, in other words, that there was an earthquake."

Dr. Brunton seems rather fond of this naturalistic or rationalistic method of explaining the miraculous element in the Old Testament records; but it is evident that the method only serves to let in miracles at the back-door instead of at the front. In this case, for instance, we cannot suppose Joshua to have known that an earthquake was about to take place, or, if he did, that its effect would be to divert the course of the river in the way that Dr. Brunton imagines. (There is a possibility, however, in the subsequent instance with which Dr. Brunton deals, of Joshua commanding the sun and moon to stand still, or become "dumb," that he expected an eclipse, and made good capital of his knowledge.) Therefore we must attribute the occurrence of the earthquake at the moment when the tribes were ready to pass over the river as due to a lucky coincidence which in itself would have been little short of miraculous. And the multiplication of such coincidences that would be required to explain all the Pentateuch miracles by this method would render their occurrence unaccountable save on the hypothesis of a designing mind; and this would constitute them miraculous in the sense of being supernatural. Moreover, many of the miracles cannot possibly be met even by the hypothesis of coincidence. Thus the passage through the Red Sea, which is so analogous to the passage through the Jordan, cannot be thus met. Here no earthquake could have produced the effect described, and if we accept the record as history we are compelled to "imagine the waters standing up as in a heap," with all the difficulty of "picturing a steep, glassy wall of water," &c. We therefore question whether the theory which led, as Dr. Brunton tells us, to the "puzzles" of his "childhood's days," was really more beset with "difficulty" than the one whereby he now endeavours to make his "Bible" square with his "Science." Better swallow miracles in the lump, and so obtain at least consistency, than try to save the historical accuracy of the Pentateuch by playing hide-and-seek with scientific principles, with the result of always losing the game.

The closing chapters of the book are occupied with an endeavour to make evolution acceptable to the orthodox mind. Here we wonder that no mention is made of the circumstance that the order in which the flora and fauna are said by the Mosaic account to have appeared upon the earth corresponds with that which the theory of evolution requires and the evidence of geology proves. On the other hand there are some original ideas which may be found of use among Churchmen of Broad Church proclivities. Thus, after quoting Milton's account of Adam and Eve in Paradise, Dr. Brunton says:—

> "This is a very beautiful picture, but it is not at all the one given in Genesis, for there we find that man, after the fall, was a being in the condition of savages of the Stone Age of Europe, clad in skins, and tilling the ground with implements of wood or stone, the use of metals being unknown till generations afterwards. And yet this being, low in the scale as we would term him, is represented as being so much higher in wisdom than Adam before the fall, that he was reckoned almost as a God in comparison, for in Genesis iii. 22, we read that 'The Lord said Behold! the man is become as one of us, to know good and evil.' So that while the Miltonic account of primitive man is an absolute contradiction of the notions of evolution, the Mosaic account is in conformity with them."

Obviously, enough allowance is not here made for what Mr. Darwin would call the "changed conditions of life" which befell Adam and Eve on being turned out of Paradise; the curse so materially altered their "environment" that, as our other apostle of evolution would say, they were no longer "in harmony" with it. Surely, then, Milton was right in representing Adam and Eve in Paradise, not as worse than "savages of the Stone Age of Europe," but rather as a happy and innocent pair living in the midst of plenty, and having access to certain trees which presented physiological properties of so remarkable a character that we greatly wish Dr. Brunton, with his well-known ability in this line of inquiry, could find an opportunity of making them the subject of his next experimental research.

Less open to criticism is the following:—

> "Now it is very remarkable that the doctrine of evolution, be it true or no, exactly agrees with the Mosaic account in reference to the place where man was created, whether this creation took place by special act or by evolutionary process. It took place in a paradise, where the air was balmy, where fruit-trees were plentiful, and where there were no carnivorous animals to prey upon and attack man. For man differs from the lower animals in the absence of a furry or hairy coat (although, curiously enough, such a coat is possessed by unborn children). Now, if for a moment we suppose ourselves driven to conclude that, in respect of his physical nature, man was evolved from a lower type of life, he could not have lost his hairy coat unless the air had been soft and balmy; for the essence of the doctrine is that the fittest only survive, and the fittest to survive exposure to heat or cold would not have been the naked, but the hairy individuals. Had not food been abundant and easily masticated, like the fruit of trees, man would not have lost the projecting muzzle and larger jaws of the apes, as a small jaw would be less fitted for the mastication of hard and innutritious food. Had man been liable to the attacks of wild beasts in this paradise, he could not have lost the large canines which form such powerful implements of defence in the gorilla. Nor would he have remained so long helpless, and unable to take care of himself, unless in such a paradise as we have supposed, where all the conditions of life were favourable. The children, which were long in developing, would have been at a disadvantage in the struggle for existence; they would have died off; and the progenitors of the human race could never have developed into men.
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> "The site, too, of the paradise, according to the evolution theory, agrees exactly with that indicated in the Book of Genesis, and, indeed, until I saw a map by Haeckel, the most prominent defender of the evolution theory in Germany, I was puzzled to understand the Mosaic account. It reads thus [see Genesis]. The site thus indicated with the utmost precision by Moses is perhaps the only one upon the surface of the whole earth which fulfils the demands of the doctrine of evolution. For, as we have already seen, according to this doctrine man must have been developed in a genial climate, in a spot where abundance of food existed. Now such a place might perhaps be found in a similar latitude in America, but it is agreed by all evolutionists that man could not possibly have been developed in the new world, because his affinities are altogether with the monkeys of the old world, and not with those of the new. This is the only point, too, from which man could have spread in such a way as would agree with the distribution of races which we now find.
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> "But man did not always continue to live in this paradise. He was driven out; according to the theory of evolution, he was probably forced to migrate from this sacred spot for the same reason that races have been forced to migrate ever since, namely, want of food due to increasing numbers. These increasing numbers would, first of all, consume the natural fruits of the trees; they would then be forced to till the ground, and, finally, some of them would be obliged to leave altogether. We read in Genesis that the woman was cursed in her conception being multiplied, and that the man was cursed by having to till the ground by the sweat of his brow. While in paradise he was naked, but after he left it he wore coats of skin. He had not yet learnt the use of metals, and his tools and implements must have been those of wood and stone. For, according to Genesis, it was not until several generations afterwards that Tubal-Cain taught men the use of brass and iron.
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> "However man was formed, then, the Mosaic account corresponds with what we find in the progress of civilisation—the Stone Age precedes that of Bronze and Iron. The paradise whose locality was indicated by Moses has now disappeared beneath the waters of the Indian Ocean. Whether its disappearance was preceded by some great volcanic eruption or not, and whether such an eruption is referred to in the mention of the flaming sword which turned every way, we cannot tell; but we have no indication in Genesis of the submergence of paradise until the time of the Flood, which," in accordance with Hugh Miller's idea, is supposed by our author to have been due to a subsidence of the land.

We have quoted this passage at length, because it serves to suggest that "the grand old legend" may contain in its beautiful allegory more of traditional history than the present age is always inclined to suppose. Enough has now been said to indicate the general nature of "The Bible and Science," although it may be added that it is furnished with an excellent index. It is an entertaining and instructive book, and we wish it all success.

GEORGE J. ROMANES

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

Thought-Reading

BY the courtesy of Dr. G. M. Beard of New York I had the opportunity of witnessing some interesting experiments in artificial trance performed on one of his trained patients, thought-reading being one of the phases exhibited. After his discovering objects in the usual way, I used a fine copper wire about a yard in length. I wound one end round the right hand of the patient (after he was hypnotised) and then placed his wired hand against his forehead. The patient then wandered round the room in an aimless sort of manner, the wire all the time being quite slack, but the moment I attempted, however gently, to increase the tension just sufficient for him to feel it, he instantly moved off along the direction of the wire, like a horse with a rein. I subsequently tried a thicker wire. The patient stood with his face in a direction at right angles to my own; he moved straight towards the table on my left hand, and after oscillating his head sideways as if trying to find some particular spot, he finally brought his forehead slowly but with great accuracy down upon a metal disk about 1½ inches in diameter, and at a distance of about 18 inches from the edge of the table. This was exactly what I had "willed."

The different effects produced by a slack and a stiff copper wire respectively would seem to show, clearly, that the patient cannot acquire the "will" of the operator unless the connection be sufficiently rigid to communicate the involuntary muscular action of the operator, however imperceptible such action may be to the latter himself, who wills what the patient is to do.

GEORGE HENSLOW

A Gun-Signal Recorder

IN the judgment recently delivered by Mr. Mansfield on the stranding of the steamer *Britannic*, he says:—"With respect to the signals from the Hook Tower it is stated that the gunner who discharged the gun—a twenty-four pound gun—commenced firing at 1.50 a.m. on July 4, and continued firing at intervals of ten minutes till 10.10 a.m. He took the time from his watch, as his sandglasses were unserviceable; he had no light but a dark lantern in his gunhouse. Without imputing to him intentional neglect of his duty or wilful misrepresentation, it seems to the Court that he may have been less vigilant and less accurate than men who were keenly awake to the difficulties of their position, and who must have known that the safety of the ship was involved in their taking the time between the signals with scrupulous care. In his unsupported testimony the Court cannot find that the signals from the Hook Tower were fired at regular intervals of ten minutes. Looking at the importance of accuracy between the intervals of the fog-signals, the Court wish to draw attention to the statement of the gunner that he has no relief in his duty, however prolonged it may be; nor do the Court find that there is any check, mechanical or otherwise, on the gunner to insure accurate firing."

The writer would suggest that a simple recording apparatus might be made by means of a clock controlling the movement of a strip of paper, as in the Morse telegraph; this strip being divided by transverse lines into spaces representing minutes and seconds.

A diaphragm of thin sheet iron, caoutchouc, or other suitable material, connected with a metal point as in the phonograph, would then register each explosion of the gun by depressing the point on to the paper strip, and either making a pencil-mark or a perforation. Such an instrument would be a check on the accurate firing of the gun in the station where it was placed, and the production of the strip would do much to remove the uncertainty which appears to have existed in the case above cited.

Liverpool, July 30 A. G. P.

Symbolical Logic

AS Mr. Venn appears to be really serious in accusing me of having misquoted him, I may as well give the whole sentence which contains the statement which he says I distorted. The complete sentence is this:—

"Take, for instance, such problems as those of which Prof. Jevons has discussed a sample under the name of Numerical Logic (*Pr. of Science*, p. 169), as any of those which play so large a part in Mr. Macfarlane's volume, or, still more, as those problems in Probability which Boole justly regarded as the crowning triumph of his system."

I certainly thought that in this sentence the last relative pronoun *which* referred to Boole's probability problems in general, but especially to that much discussed problem (sometimes called his "challenge problem") which Boole gave in illustration of what he conceived to be the superiority of his "general method" over the usual methods. It never struck me therefore that Mr. Venn would seriously accuse me of misquoting him because (in order not to inflict upon the readers of NATURE the irrelevant three-quarters of the above sentence) I represented him as saying that Boole "justly regarded *his problems in probability* as the crowning triumph of his system." What then are the problems to which Mr. Venn refers? This, I own, is not a point upon which I have "any claim to call for an answer," but I think it is a point upon which he might courteously condescend to gratify the natural curiosity of many admiring readers of his "Symbolic Logic," who (unlike me, I am afraid) cannot be suspected of any unkind wish to place him in a difficulty.

Boulogne-sur-Mer, August 2 HUGH MCCOLL

Bisected Humble-Bees

AT the end of my garden two magnificent lime-trees grow, on which bees—of specimens of which I herewith send you portions—feed at this time of the year by hundreds—by thousands. What kind of bees are they? But the following are the points on which I should like some information. Every morning I find numbers of them on the ground, helpless, behaving very much like men when they are drunk. What causes this? Next, how comes it to pass that, apparently, these helpless bees all become bisected or trisected as the specimens I send? This morning there are hundreds of portions under the trees. We have a family of "fly-catchers" in the garden—would they do it?

T. MASHEDER

The Grammar School, Ashby-de-la-Zouch, July 29

[The bees are a common species of Bombus (Humble-bees), mostly workers, and mostly bisected at the junction of thorax and abdomen. Perhaps wasps are the culprits, adopting this method in order to rob the bees of their honey-bags. We shall be glad to have information on this point.—ED.]

A New Meter for Electric Currents

IN NATURE, vol. xxiv. pp. 294–5, you notice a new meter for electric currents, giving a description which is fairly correct for a slight sketch, and attributing the invention to Mr. Edison. The invention, however, is not American, but English, and, as the inventor, I think myself entitled to whatever credit this entirely novel system may merit. My patent rights for America have been purchased of me, and the invention will be shortly in use in New York.

JOHN T. SPRAGUE

Birmingham

[Our correspondent is doubtless right in his claim. Nevertheless the invention we referred to in the brief note in question has been recently patented in this country on behalf of Mr. Edison, presumably at a later date than our correspondent's invention. We should be glad if he would kindly furnish us with the date of his English patent. We certainly meant no injustice in publishing the note.—ED.]

A POPULAR ACCOUNT OF CHAMÆLEONS[1]

II.

THE next most interesting of the animal's life processes is its change of colour. Mistakes and exaggerations as to this matter are of very old date. Aristotle believed

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[1] Lecture delivered at the Zoological Gardens on July 28, 1881, by St. George Mivart, F.R.S. Continued from p. 312.